



PIER Energy-Related Environmental Research

Environmental Impacts of Energy Generation, Distribution and Use

Quantifying the Greenhouse Gas Emissions Generated by the Consumption Patterns of California Residents

Contract #: 500-02-004; UC MR-069-02; MEX-07-03

Contractor: Lawrence Berkeley National Laboratory

Contract Amount: \$75,000

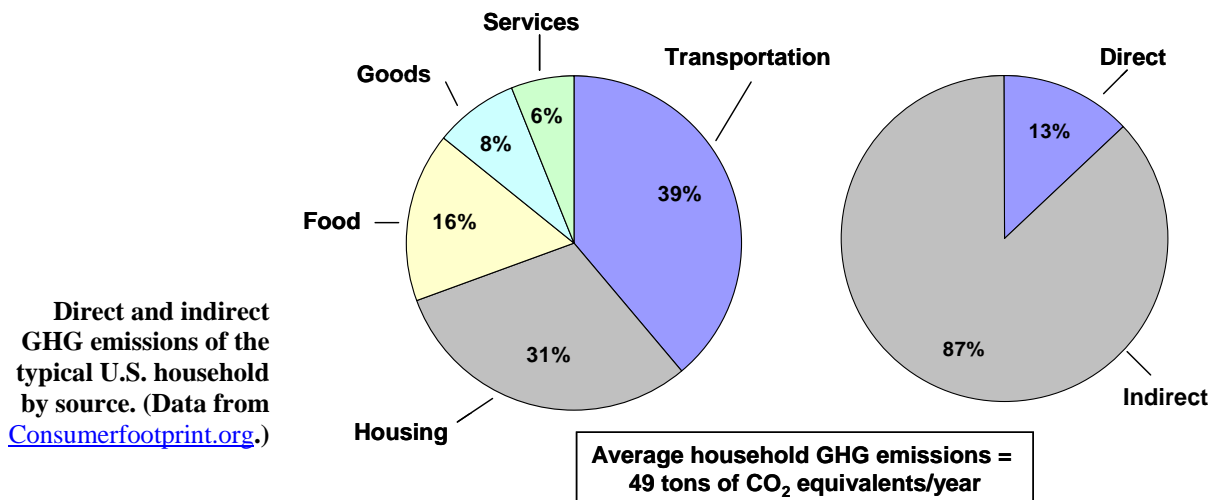
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The Issue

California's Global Warming Solutions Act of 2006 (AB 32) requires that by 2020 the state's greenhouse gas (GHG) emissions be reduced to 1990 levels, which represents a roughly 25% reduction compared to current GHG emissions trends. Previous studies suggest that personal consumption—such as travel, the operation of homes, and purchased goods and services—can account for more than 80% of total energy demand and related GHG emissions in the United States when both direct and indirect effects are considered (see figure).^{1,2} A promising approach for meeting the aggressive GHG reduction targets of AB 32 is, therefore, to identify and reduce the GHG emissions associated with the personal consumption activities that most influence California's annual energy demand and related GHG emissions.



¹ The indirect energy of goods and services refers to the total “cradle-to-use” energy required to provide goods and services for consumer consumption. The indirect energy associated with a given good or service includes all energy consumed in the transportation, industrial, and commercial sectors to produce that good or service. Thus, in theory, the vast majority of U.S. energy consumption in the transportation, industrial, and commercial sectors is embodied as indirect energy in the goods and services those sectors provide to the end consumer.

² Shui, B., and H. Dowlatabadi. 2005. “Consumer Lifestyles Approach to U.S. Energy Use and CO₂ Emissions.” *Energy Policy*, 33(2): 197–208.

However, neither existing personal GHG emissions calculators nor California's annual GHG emission inventory can develop accurate, consumption-based analyses of the state's GHG emissions. While available GHG emissions calculators can often quantify both direct and indirect GHG emissions, these tools are not capable of determining the fractions of one's GHG emissions that occur inside and outside of California. Thus, the extent to which indirect GHG emission reduction opportunities may actually lead to in-state GHG emissions reductions is not clear. Additionally, available calculators do not take into account California's unique electrical generating mix, which leads to fewer GHG emissions per kilowatt-hour in than most other U.S. states. Furthermore, only GHGs emitted within state boundaries are counted in California's annual GHG inventory. This leads to an underestimation of the total direct GHG emissions necessary to support the consumption activities of California residents, because California imports a significant fraction of its electricity (37% in 1999) from neighboring states.³

Improved methods for estimating consumption-related GHG emissions in California that address these deficiencies will allow state policy makers to analyze how personal consumption can be shifted away from products and services that entail high levels of GHG emissions toward more sustainable options. Such improved methods could be a powerful tool in identifying strategies for meeting California's aggressive AB 32 emission reduction targets.

Project Description

Funded by PIER's Exploratory Environmental Grants Program, this research seeks to use the best-available data sources to explore the direct and indirect GHG emissions generated as a result of the consumption activities of California residents. This will be accomplished in three primary tasks:

1. Develop an understanding of the consumption activities of California residents for a selected year. Information on California consumer expenditures on a wide range of goods and services, including food, healthcare, electronics, apparel, entertainment, gasoline, and education, will be derived from literature sources, including the U.S. Bureau of Labor Statistics' Consumer Expenditure Survey.⁴
2. Quantify California's total (i.e., direct and indirect) consumption-based GHG emissions for a selected year and determine, in a preliminary fashion, the percentages of indirect GHG emissions occurring inside and outside the state. Based on the information obtained regarding the consumption activities of California residents, direct GHG emissions will be estimated using California-specific electricity and fuel emissions factors. Indirect GHG emissions generated from the supply chain of products and services will be estimated using Carnegie Mellon University's Economic Input-Output Life Cycle Assessment (EIO-LCA) model, modified for California using economic census data (e.g., production, import, and export data).⁵

³ Marnay, C., Fisher, D., Murtishaw, S., Phadke, A., Price, L., and Sathaye, J. 2002. *Estimating Carbon Dioxide Emissions Factors for the California Electric Power Sector*. Berkeley, CA: Lawrence Berkeley National Laboratory (LBNL-49945).

⁴ U.S. Bureau of Labor Statistics. 2001. *Consumer Expenditure Survey 2001*. Washington, DC: BLS.

⁵ Carnegie Mellon University's EIO-LCA model can be accessed at <http://www.eiolca.net/>.

3. Provide a preliminary analysis of the key consumption activities driving California's consumption-based GHG emissions and explore possibilities for changes in consumption patterns that might offer the greatest reductions in California's total GHG emissions. This task will address opportunities for GHG emissions reductions both inside and outside of the state.

PIER Program Objectives and Anticipated Benefits for California

This project offers numerous benefits and meets the following PIER program objectives:

- **Evaluate and resolve environmental effects of energy production, delivery, and use in California.** This project provides a first-ever means of evaluating both the direct and indirect GHG implications of consumption-based strategies for reducing California's total GHG emissions. Opportunities identified through this research could be promoted via official policy mechanisms leading to less energy- and GHG-intensive consumption activities, with a resulting decrease in GHG and criteria pollutant emissions.
- **Provide affordable energy.** Decreased use of electricity, natural gas, and transportation fuels would lead to reduced energy bills for consumers and could also decrease reliance on imported fuels (e.g., electricity imports).

Final Report

PIER-EA staff intend to post the final report on the Energy Commission website in fall 2008 and will list the website link here.

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